SOLID STATE POWER AMPLIFIER

M-2000

SERVICE MANUAL

MODEL: M -2000

CURCUIT DESCRIPTION

We are sure that you could understand an entire circuitry more precisely by use of the diagram of power amp section together with the whole block diagram. As for the signal paths, both channels are identical with only the difference of the TR number. Therefore only the left channel diagram is shown , and explanation is made accordingly. Transistors are marked with Q.

1) Emitter Follower Circuit

Output signals of a control amplifier etc. are led to the input terminals (MAIN IN) of this power amp , and level-controlled at the input level control of a detent volume equivalent to the high-grade attenuator with 22 contact-points of 1dB decrement. Then fed into the Emitter Follower Circuit, which is, different from the ordinary one, composed by two transistors Q101 and Q102. The former is for emitter follower of Q101.

Signals are impedance-converted through this circuit, and therefore electrical isolation is made between the output stage of a control amp and the pre-driver circuit of this amplifier to eliminate interference between both circuits. Thus stable amplification with low distortion is attained.

2) Pre-Driver Circuit

Signals converted into low impedance at emitter follower circuit are then fed to the two-stage differential amplifier, a kind of balanced DC amplifying circuit, to meet voltage amplification. The differential amplifier is always stable against possible fluctuation of mains voltage and temperature drift, and has been widely used as Operational Amplifier with IC's in computors or measurement instruments etc. The two PNP transistors Q201, Q202 for the 1st stage differentail amplifier are arranged quite symmetrically, and the emiter of the both transistors are connected to (+) power supply through a common resistor. The base of Q201 accepts the input signal, while that of Q202 accepts the feedback signal. Due to adoption of the two transistors of the same standard, equivalent current is to the base of the both transistors. As emitter current for two pieces will rise up accordingly, which corresponds to negative feedback. On the other hand, if subtle (+) potential may appear at the speaker terminals by the drift of transistors caused by other factors but signals, for instance, the raise up of temperature , this (+) potential is led to the base of Q202 via the feedback circuit, when (+) signal of the same phase will appear at the emitter resistor. In this case, the potential at the emitter resistor of Q201 varies to (+), which reduces the collector current to have (-) potential at collector. The voltage is amplified by the 2nd differential amplifier by the 2nd differential amplifier Q203, Q204, which makes the (+) potential stable at the speaker terminals, and makes it possible to keep balanced 0 potential.

The 2nd differential amplifier operates same as the 1st one, though not perfectly symmetrical. The constant current drive by Q205 is applied, since this stage aims at voltage amplification. The emitter follower circuit is arranged annexed to the differential amplifier with a pair of Q206 and Q207. (Q206 is for the emitter follower and Q207 is for its constant current driving.) Therefore, impedance flucuation caused by the speaker loads would not affect the pre-driver stage.

With this pre-driver circuit, stable driving with low distortion is feasible up to high frequency range with smaller phase compensation comparing with conventional high power amplifiers. As for the power supply circuit for class "A" operation sections up to the differential stage, a real automatic voltage regulator is adopted to avoid bad influence which may possibly be caused by the flucuation of AC mains voltage or the current flucuation in the power amplifier section.

3) Power Output Circuit

Adopted is a pure complementary push-pull circuit composed by the power transistors of NPN group and PNP group. In order to produce such a high power of 120W/ch, parallel push-pull stages utilizing 4 power transistors designed for high power output are arranged at the final stage. Thus sufficient driving of various type of the speaker systems is feasible.

The parallel configuration of the power transistors at the final stage allows the instant collector-dissipation increase in accordance with the number of the transistor, which produces enough margin, and at the same time makes it possible to utilize better linearity portion of the hfe-ic characteristics of each transistor to lower the distortion characteristic.

Further the quiescent current of 35mA in the single push-pull configuration will be doubled into 70mA in the parallel push-pull configuration, which means the distortion characteristic is improved even at the low output level.

4) Bias Circuit

The adjustment of the quiescent current at the final stage is make by a thermal diode and the transistor Q208. The diode compensates the excessive heat and the temperature drift.

5) Protection Circuit

The OCL circuit, in which the speaker system is directly connected to the amplifier, is ideal in the point that the input signal is delevered most faithfully. But this circuit is always accompanied by the danger that any abnormal factors aroused in the amplifier will be delivered to the speaker system without barrier. On the other hand, electronic components will increase in its number in proportion with improvements of the circuit design, and it is hard to foresee every trouble that may happen, even if the most severe selection is made for the superior components. Necessity is here to have the protection circuits. The most important in the operation of the protection circuitry is reliability and speed. Therefore the sensitivity should be as high as possible in the range of the safety operation.

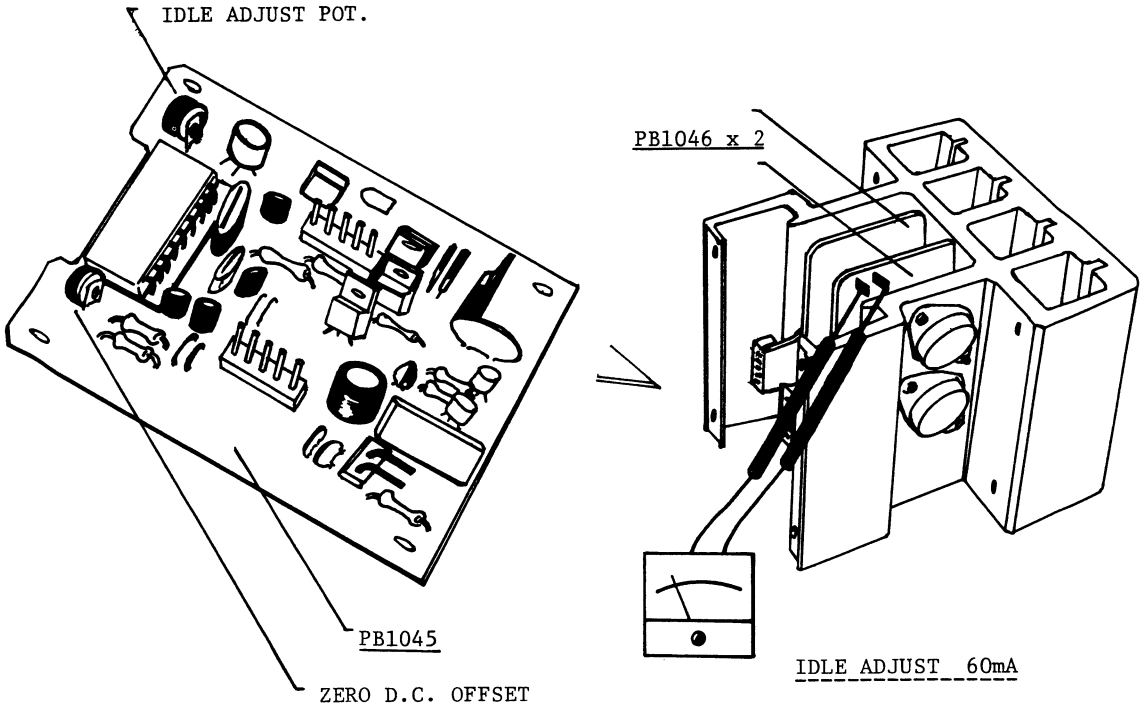
The protection circuits of the M-2000 have to be designed not to be mis-functioned by the current of music reproduction signal. The block diagram will help you understand the outline of the protection circuits.

As to the over-current sensing, when excessive current, which may break the power transistors, appears, the current is once restrained electronically to keep the operation of the power teansistors in the S.O.A. (Safe Operation Area). And in case the restraint time lasts over a certain time, the mains power is shut off by fuses.

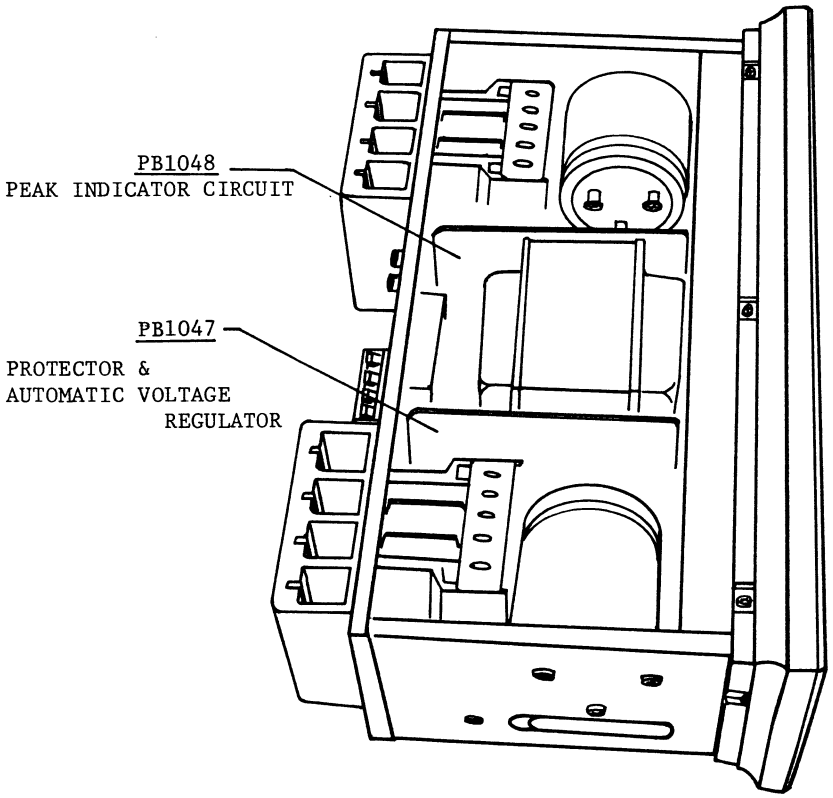
Furthermore, the D.C. Drift Sensing is adopted, which protects the speaker system by cutting off the output when some $\pm$3V D.C. is detected at the speaker terminals. This also operates as the muting circuit which protects the speaker system from transient phenomena cuased by the AC power being turned on.

Thus the M-2000 is eqipped with double protection circuits. One is for protection of speaker systems, and another is for protection of the amplifier.

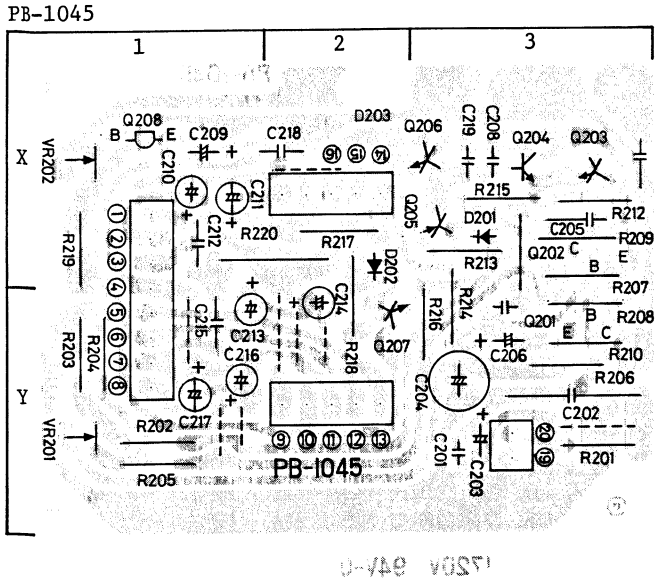
IDLE CURRENT & ZERO DC OFFSET



P.C.B. LOCATION



PB-1045



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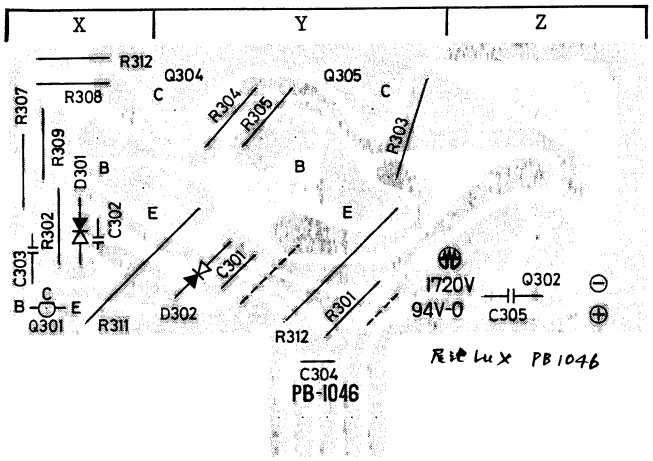
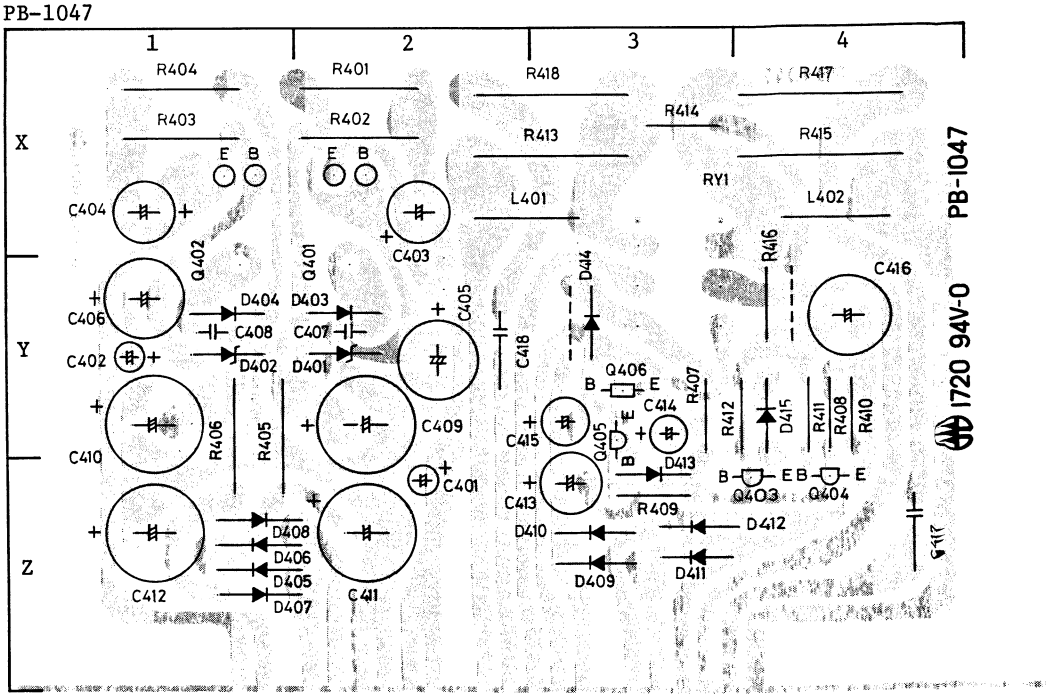
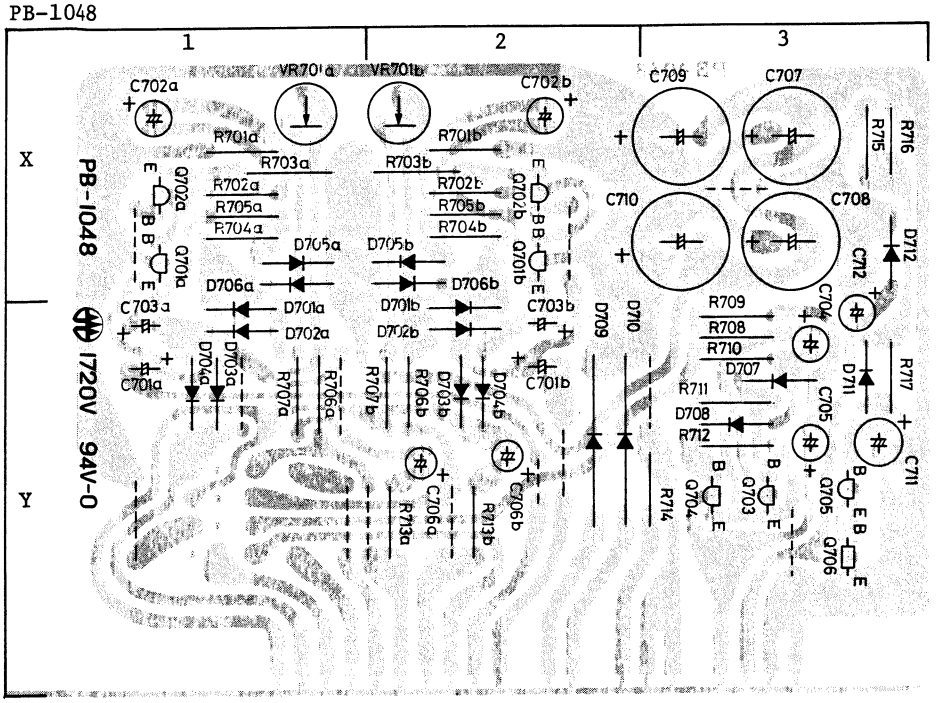


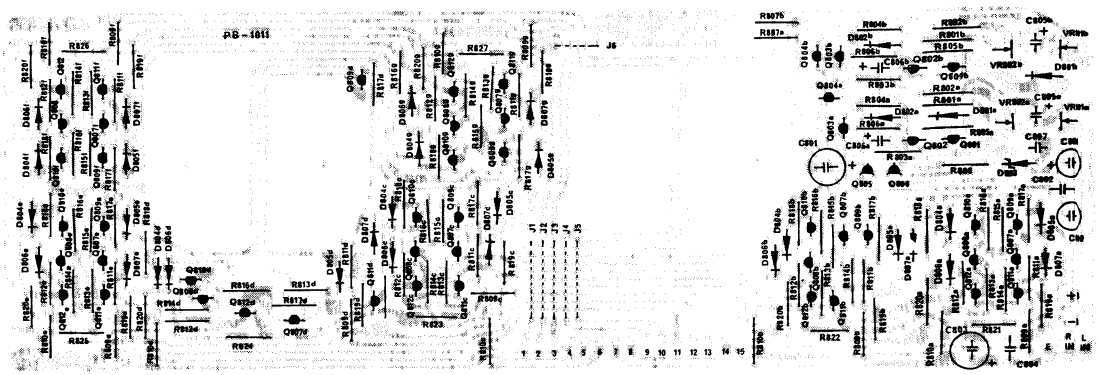
PB-1047



PB-1048



PB-1011



M-2000 REPLACEMENT PARTS LIST

PB-1045 (Resistors; ±5%, 1/4W unless otherwise noted.)

R201	4.7K	3Y	R208	3.3K	3Y	R215	150	3X
202	33K 1/2W	1Y	209	3.3K	3X	216	47K	3Y
203	220	1Y	210	1.2K	3Y	217	47K 1/2W	2X
204	220	1Y	212	JAMPER	3X	218	100 1/2W	2Y
205	33K 1/2W	1Y	213	150	3X	219	8.2K	1X
206	56K	3Y	214	47K	3Y	220	10 1W	2X
207	39K	3Y						

(E): electrolytic, (M): mylar, (S): styrol, (P): polyester film,
(T): tantalum, (C): ceramic

C201	220pF	C	3Y	C211	1uF 100V	E		1X
202	1.2uF 250V	P	3Y	212	0.01uF	C		1X
203	10uF 16V	T	3Y	213	1uF 100V	E		1Y
204	33uF 16V	T	3Y	214	1uF 100V	E		2Y
205	470pF	C	3X	215	0.01uF	C		1Y
206	47uF 10V	T	3Y	216	1uF 100V	E		1Y
207	110pF	C	3Y	217	1uF 100V	E		1Y
208	33pF	C	3X	218	0.047uF 50V	M		2X
209	47uF 10V	E	1X	219	100pF 500V	C		3X
210	1uF 100V	E	1X					

Q201	2SA931	3Y	Q205	2SA839	3X
202	2SA931	3X	206	2SC1507	3X
203	2SC1507	3X	207	2SC1507	2Y
204	2SC1507	3X	208	2SC945	1X

D201	VD-1221	3X
202	VD-1221	2X
203	SV-03	2X

PB-1046 (Resistors; ±5%, 1/4W unless otherwise noted.)

R301	220	Y	R308	100		X
302	1.5K	X	309	100		X
303	100 1W	Y	311	0.33	5W	X-Y
304	15 1/2W	Y	312	0.33	5W	Y
305	15 1/2W	Y				
307	220	X				

C301	2200pF	M	Y		
302	4.7pF	C	X		
303	0.02uF	M	X		
304			Y		
305	0.1uF 250V	C	Z		

Q301	2SC945 or 2SA733	X	D301a	1S1555
302	2SC1431 or 2SA762	Z	301b	1S1555
304	2SD427 or 2SB557	Y	302a	1S1555
305	2SD427 or 2SB557	Y	302b	1S1555

PB-1047

R401	15K	1W	2X	R407	82K	3Y	R413	10 2W	3X
402	5.6K	1W	2X	408	10K	4Y	414	8.2K	3X
403	15K	1W	1X	409	150K	3Z	415	10 2W	4X
404	5.6K	1W	1X	410	1K	4Y	416	8.2K	4Y
405	150	1W	1Y	411	3.3K	4Y	417	4.7 5W	4X
406	150	1W	1Y	412	1.5K	4Y	418	4.7 5W	3X

PB-1047

C401	1uF	100V	E	2Z	C410	100uF	100V	E	1Y
402	1uF	100V	E	1Y	411	100uF	100V	E	2Z
403	220uF	16V	E	2X	412	100uF	100V	E	1Z
404	220uF	16V	E	1X	413	47uF	50V	E	3Z
405	100uF	63V	E	2Y	414	10uF	10V	E	3Y
406	100uF	63V	E	1Y	415	10uF	50V	E	3Y
407	100pF		C	2Y	416	100uF	25V	E	4Y
408	100pF		C	1Y	417	4.7uF	50V	E	4Z
409	100uF	100V	E	2Y	418	0.1uF	100V	C	2Y

Q401	2SD382	2X	Q404	2SC945	4Z
402	2SB537	1X	405	2SC945	3Y
403	2SC945	4Z	406	2SC945	3Y

D401	1N4558A	2Y	D409	1N4003	3Z	L401	2.2uH	2X-3X
402	1N4558A	1Y	410	1N4003	3Z	402	2.2uH	4X
403	1N4001	2Y	411	1N4003	3Z			
404	1N4001	1Y	412	1N4003	3Z			
405	1N4003	1Z	413	1K188	3Z			
406	1N4003	1Z	414	1N4001	3Y			
407	1N4003	1Z	415	1K188	4Y			
408	1N4003	1Z						

PB1048

R701a	22K	1X	R706a	56K	1Y	R714	1.5K	3Y
701b	22K	2X	706b	56K	2Y	715	8.2K	3X
702a	10K	1X	707a	47K	1Y	716	1.5K	3X
702b	10K	2X	708	1.2K	3Y	717	100K	3Y
703a	100	1X	709	33K	3Y			
703b	100	2X	710	47K	3Y			
704a	33K	1X	711	1.2M	3Y			
704b	33K	2X	712	1.2M	3Y			
705a	1.8K	1X	713a	18K	2Y			
705b	1.8K	2X	713b	18K	2Y			

C701a	4.7uF	10V	T	1Y	C706a	22uF	10V	E	2Y
701b	4.7uF	10V	T	2Y	706b	22uF	10V	E	2Y
702a	10uF	50V	E	1X	707	220uF	35V	E	3X
702b	10uF	50V	E	2X	708	220uF	35V	E	3X
703a	4.7uF	25V	T	1Y	709	220uF	35V	E	3X
703b	4.7uF	25V	T	2Y	710	220uF	35V	E	3X
704	10uF	25V	E	3Y	711	33uF	25V	E	3Y
705	10uF	25V	E	3Y	712	10uF	50V	E	3Y

Q701a	2SC945	1X	Q703	2SC945	3Y
701b	2SC945	2X	704	2SC945	3Y
702a	2SC945	1X	705	2SC945	3Y
702b	2SC945	2X	706	2SC1940	3Y

D701a	WG-713 or 1S1555	1Y	D704a	WG-713 or 1S1555	1Y	D707	WG-713 or 1S1555	3Y
701b	WG-713 or 1S1555	2Y	704b	WG-713 or 1S1555	2Y	708	WG-713 or 1S1555	3Y
702a	WG-713 or 1S1555	1Y	705a	WG-713 or 1S1555	1X	709	1N4003	2Y
702b	WG-713 or 1S1555	2Y	705b	WG-713 or 1S1555	2X	710	1N4003	2Y
703a	WG-713 or 1S1555	1Y	706a	WG-713 or 1S1555	1X	711	1K188	3Y
703b	WG-713 or 1S1555	2Y	706b	WG-713 or 1S1555	2X	712	1N4002	3X

VR701a	100K-B	1X
701b	100K-B	2X

PB-1011

R801 a,b	180K	±5%	R821	562	±1%	Q804a,b	2SA561
802 a,b	4.7K	"	822	392	"	805a,b	2SC734
803 a,b	22K	"	823	280	"	806	2SC734
804 a,b	82K	"	824	196	"	807 a-g	2SA561
805 a,b	10K	"	825	140	"	808 a-g	2SA561
806 a,b	18K	"	826	97.6	"	809 a-g	2SC734
807 a,b	6.8K	"	827	239	"	810 a-g	2SC734
808	2.7K	"				811 a-g	2SC734
809 a-g	820	"	C801	100uF 35V	E	812 a-g	2SC734
810 a-g	820	"	802	0.1uF	C		
811 a-g	1.2M	"	803	100uF 35V	E	D801 a,b	wG713
812 a-g	1.2M	"	804	0.1uF	E	802 a,b	WG713
813 a-g	1K	"	805a,b	4.7uF 25V	T	803	BZ192
814 a-g	1K	"	806a,b	1uF 25V	T	805 a-g	WG713
815 a-g	4.7K	"	807a,b	0.022uF	M	806 a-g	WG713
816 a-g	4.7K	"	808	10uF 25V	E	807 a-g	WG713
817 a-g	56K	"	809	10uF 25V	E	808 a-g	WG713
818 a-g	56K	"	Q801a,b	2SC734		VR801 a,b	47K-B
819 a-g	22K	"	802a,b	2SC734		802 a,b	1K-B
820 a-g	22K	"	803a,b	2SC734			

PB-1012

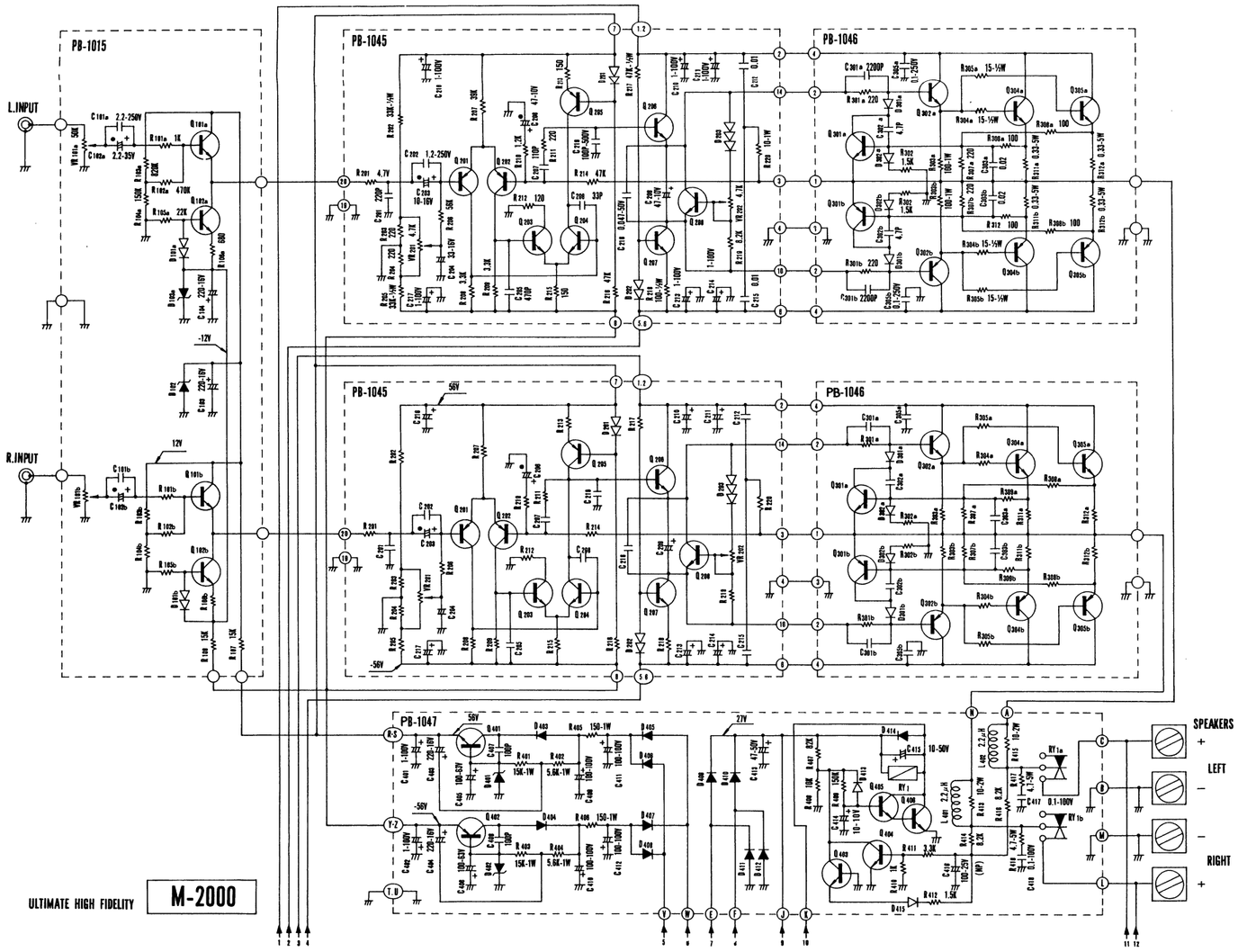
LED L1 - 7	GL-31AR
R1 - 7	GL-31AR
LED	GL-52AY

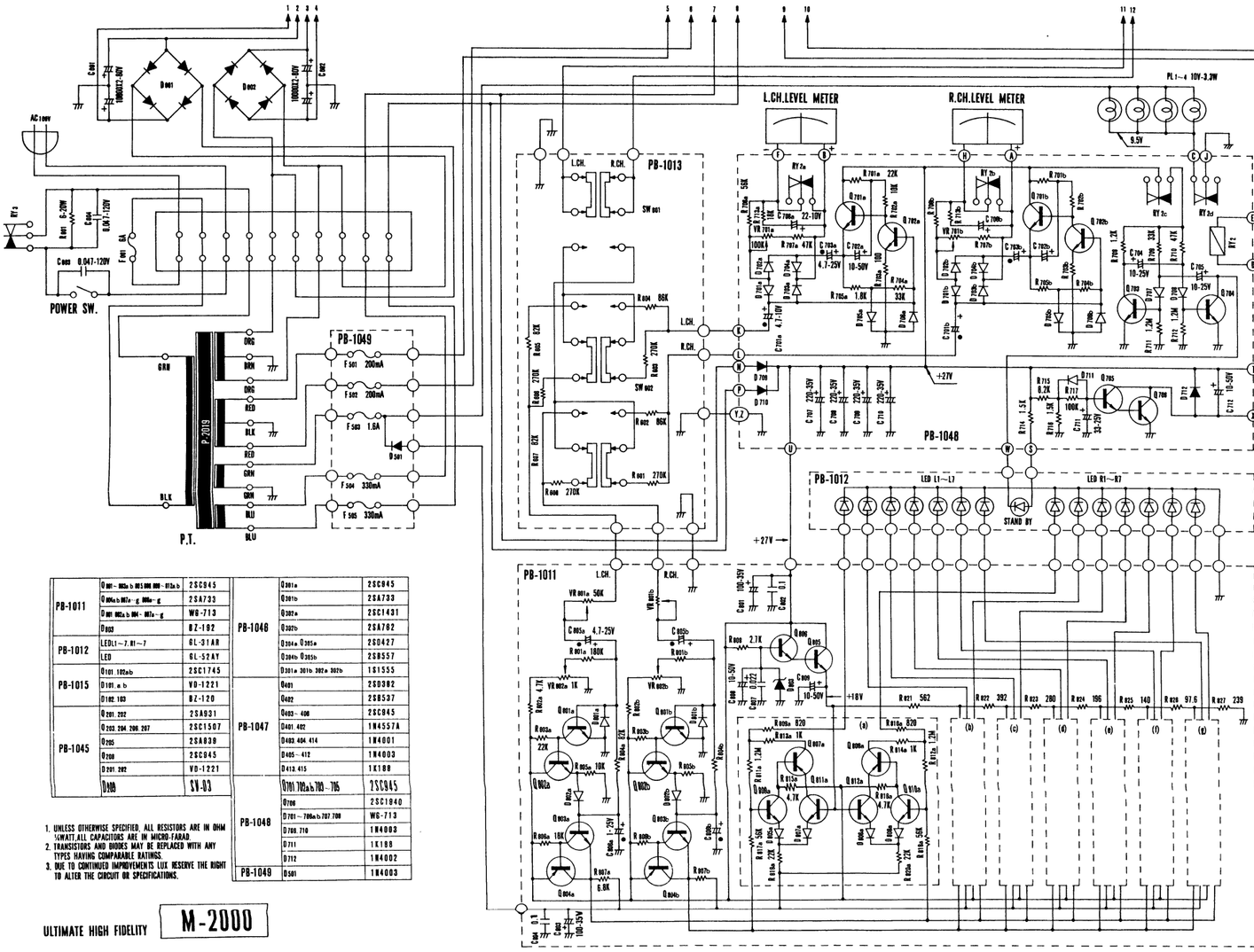
PB-1015

R101 a,b	50K	C101 a,b	2.2uF	250V	P	D101 a,b	VD1221
102 a,b	470K	102 a,b	2.2uF	35V	P	102	BZ120
103 a,b	820K	103	220uF	16V	E	103	BZ120
104 a,b	150K	104	220uF	16V	E		
105 a,b	22K					VR101 a,b	50K-B
106 a,b	680	Q101 a,b	2SC1745				
107	15K	102 a,b	2SC1745				
108	15K						

PB-1049

D501	1N4003





PB-1011	Q101 - 103a b 105 106 109 - 113a b	2SC945
	Q104a b 107a - g 108a - g	2SA733
	Q108 109a b 104 - 107a - g	WB-713
	D103	BZ-192
PB-1012	LED L1 - 7, R1 - 7	GL-31AR
	LED	GL-52AY
PB-1015	Q101. 102a b	2SC1745
	D101. a b	VD-1221
	D102. 103	BZ-120
PB-1045	Q201. 202	2SA931
	Q203. 204. 206. 207	2SC1507
	Q205	2SA839
	Q208	2SC945
	D201. 202	VD-1221
	D208	SV-93

PB-1048	Q301a	2SC945
	Q301b	2SA733
	Q302a	2SC1431
	Q302b	2SA762
	Q304a Q305a	2SD427
	Q304b Q305b	2SB557
	D301a 301b 302a 302b	1S1555
PB-1047	Q401	2SD382
	Q402	2SB537
	Q403 - 406	2SC945
	D401. 402	1N4557A
	D403. 404. 414	1N4001
	D405 - 412	1N4003
	D413. 415	1K188
PB-1048	Q701 702a b 703 - 715	2SC945
	Q706	2SC1940
	D701 - 706a b 707 708	WG-713
	D708. 710	1N4003
	D711	1K188
	D712	1N4002
PB-1049	D501	1N4003

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHM 1/4WATT, ALL CAPACITORS ARE IN MICRO-FARAD.
2. TRANSISTORS AND DIODES MAY BE REPLACED WITH ANY TYPES HAVING COMPARABLE RATINGS.
3. DUE TO CONTINUED IMPROVEMENTS LUX RESERVE THE RIGHT TO ALTER THE CIRCUIT OR SPECIFICATIONS.

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